Tracking: Errors used in fits

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Fig. 1 shows the χ^2, $\chi^2/\mathbf{n}$, and the quantities $\mathbf{y_1}$, and $\mathbf{y_2}$, defined as

$$\mathbf{y_1 = (\chi^2 - n)/\sqrt{(2n)}}$$

$$\mathbf{y_2} = \sqrt{(2(\chi^2)} - \sqrt{(2n-1)}$$

where **n** is the number of degrees of freedom, for tracks fitted in the data data of periods 3 and 4.

Clearly, the $\chi^2/\mathbf{n}$ does not peak at **1**. In addition, if everything is OK, the quantities $\mathbf{y_1,y_2}$ should have a **normal** distribution with mean at **zero** and standard deviation of **1**. As seen in Fig.1, y_1,y_2 are not behaving in the expected way.

One possible reason may be that the errors used in the overall fit are overestimated.

To show this I run some MC experiments:

I generated (10000 events) straight lines (50 z-x pairs) and then I used a gaussian error σ_ε to fudge the data. I fitted this ‘experimental straight line’ assuming various errors in the fit:

σ **=**	**1** σ_ε	(Fig. 2)	Normal case
	0.7 σ_ε	(Fig.3)	Underestimated
	2σ_ε	(Fig.4)	Overestimated
	3σ_ε	(Fig. 5)	

As shown in these figures underestimation or overestimation of the errors moves the distributions of y_1, y_2 **away from zero and change their widths**. In Figs 6,7 one can see the way that the **mean** and σ depend on the factor f (σ **= f** σ_ε). In Figs 8,9 I have run the MC with straight lines made out of 5-40 points (this number was generated uniformly in this interval, in order to simulate different number of degrees of freedom) with two classes of straight lines:

- ♦ 1/3 of events with σ **= 3**σ_ε
- ♦ 2/3 of events with σ **= 1.5** σ_ε

in order to create y_1,y_2 distributions that look like the data in Fig. 1.

Conclusion-question

Does this affect

- ♦ **Momentum estimation**
- ♦ **Vertex fitting**

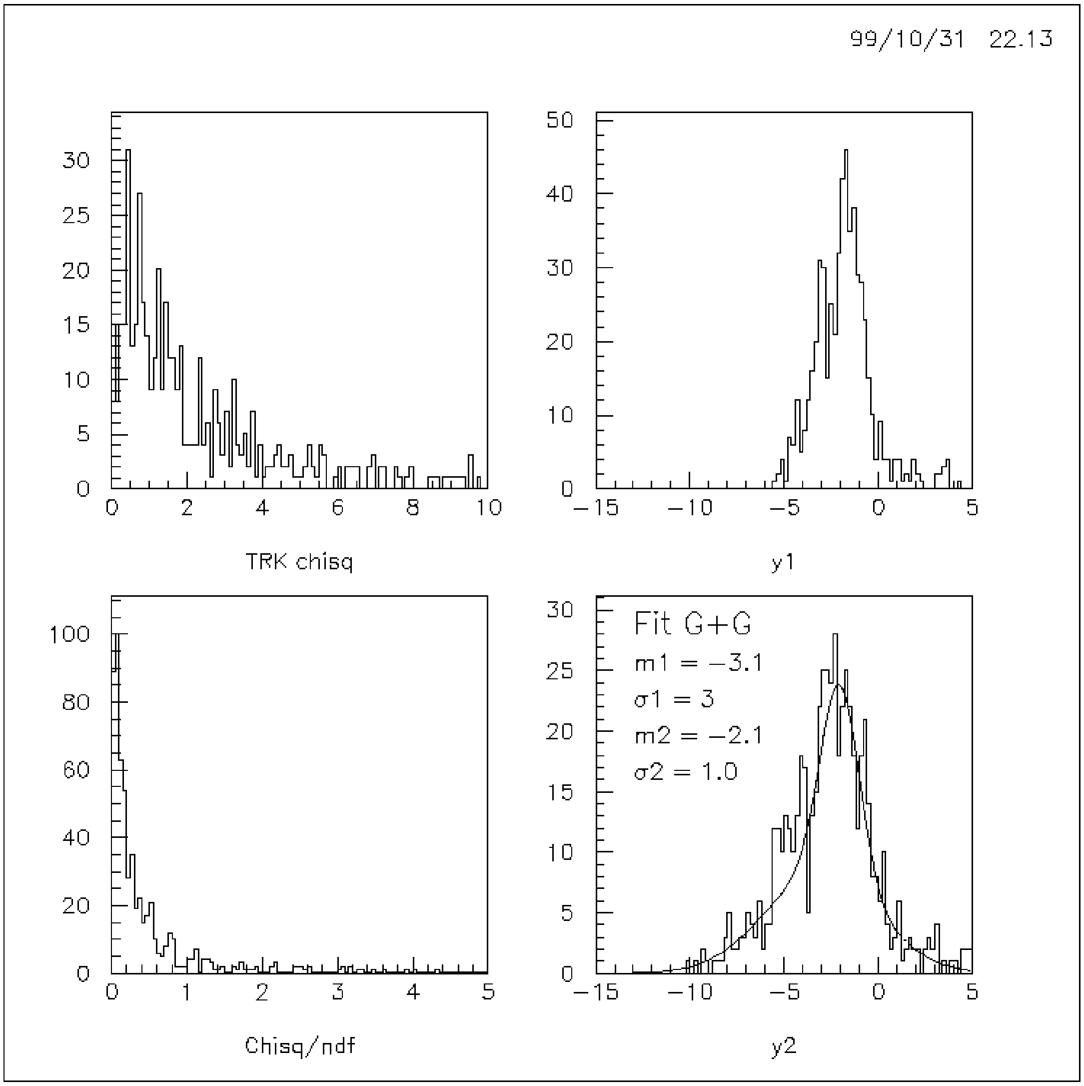

Fig. 1: Muon events from periods 3,4

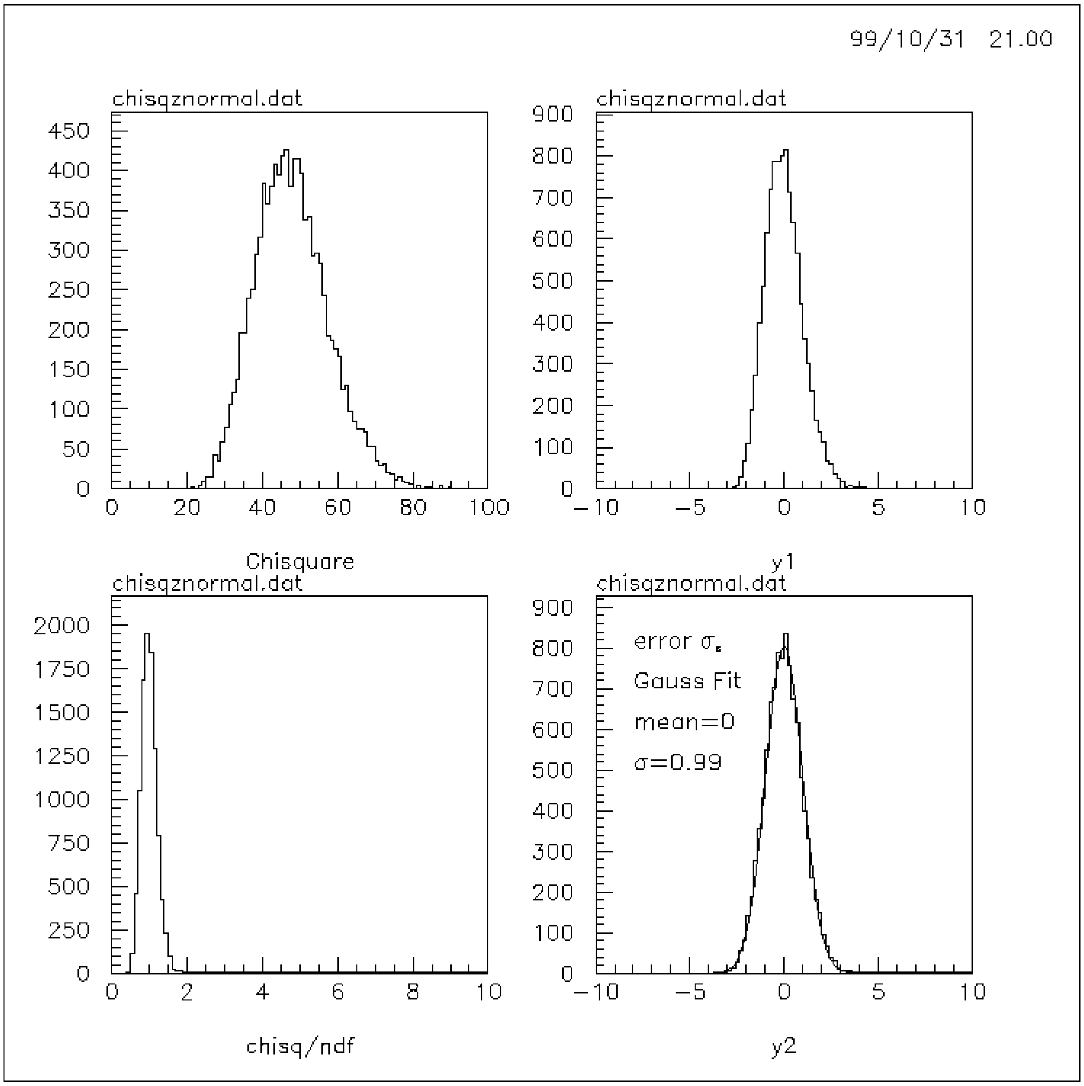

Fig. 2: Monte Carlo , f=1, (Normal)

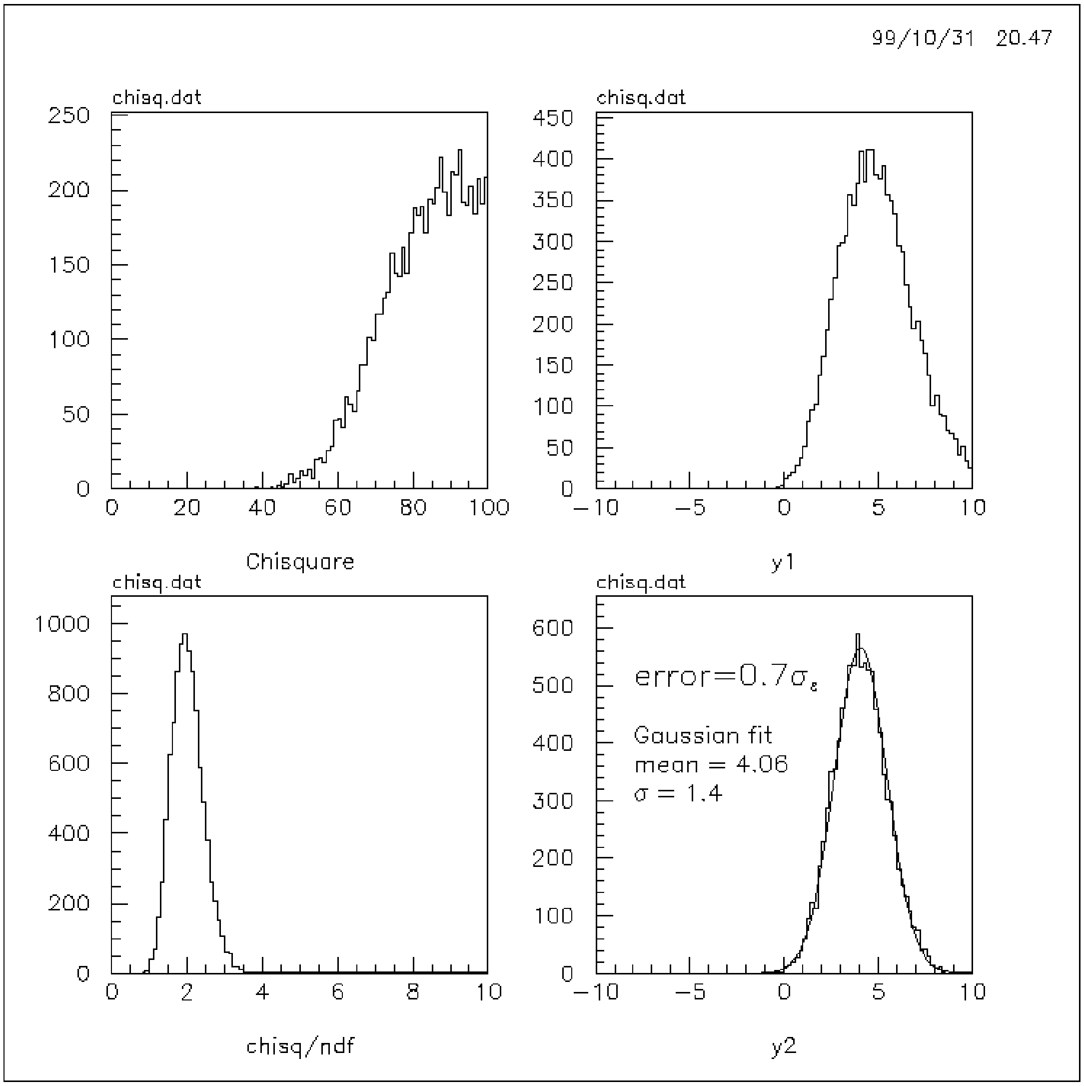

Fig. 3: MC, f=0.7 (Underestimated error)

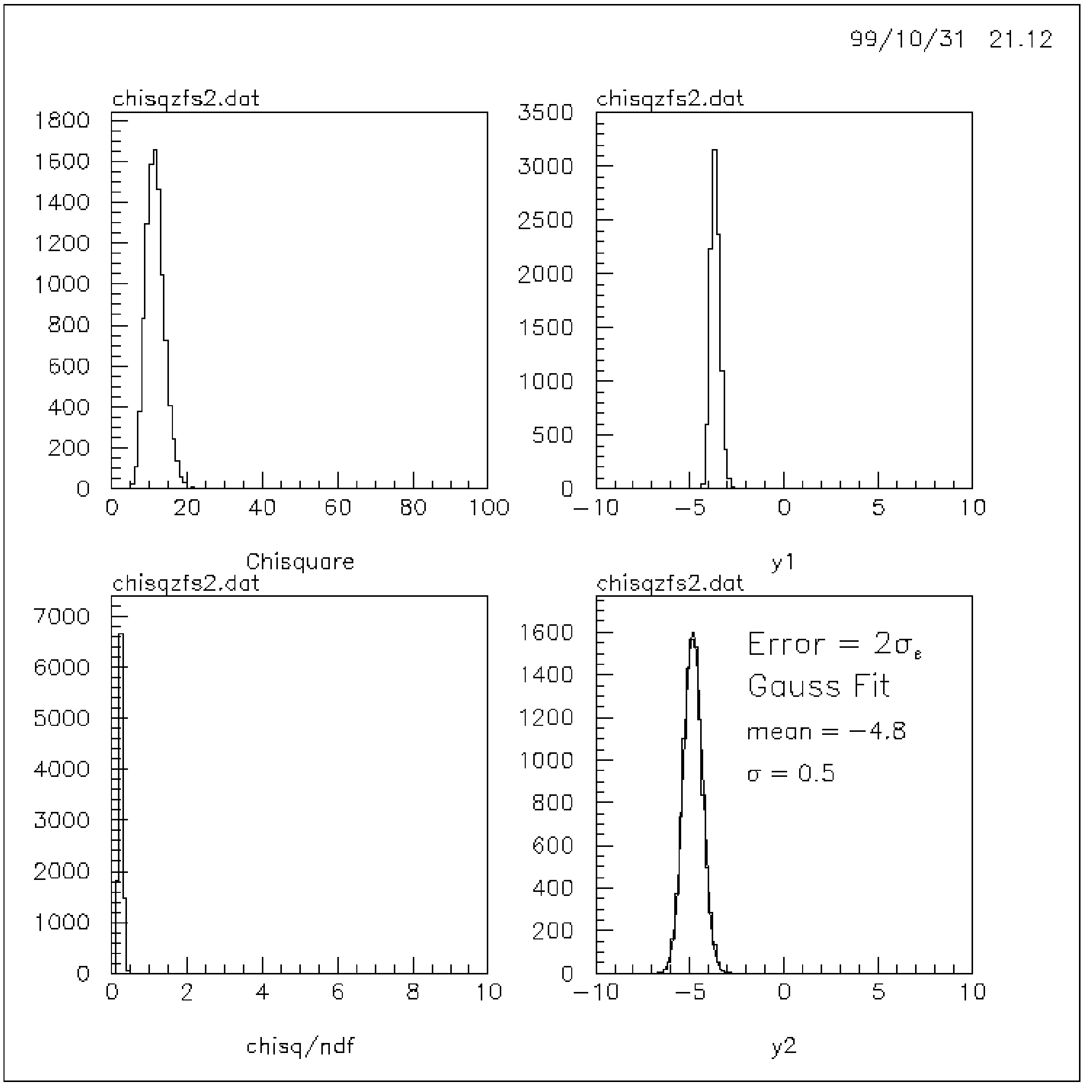

Fig. 4: MC, f = 2, (Overestimated errors)

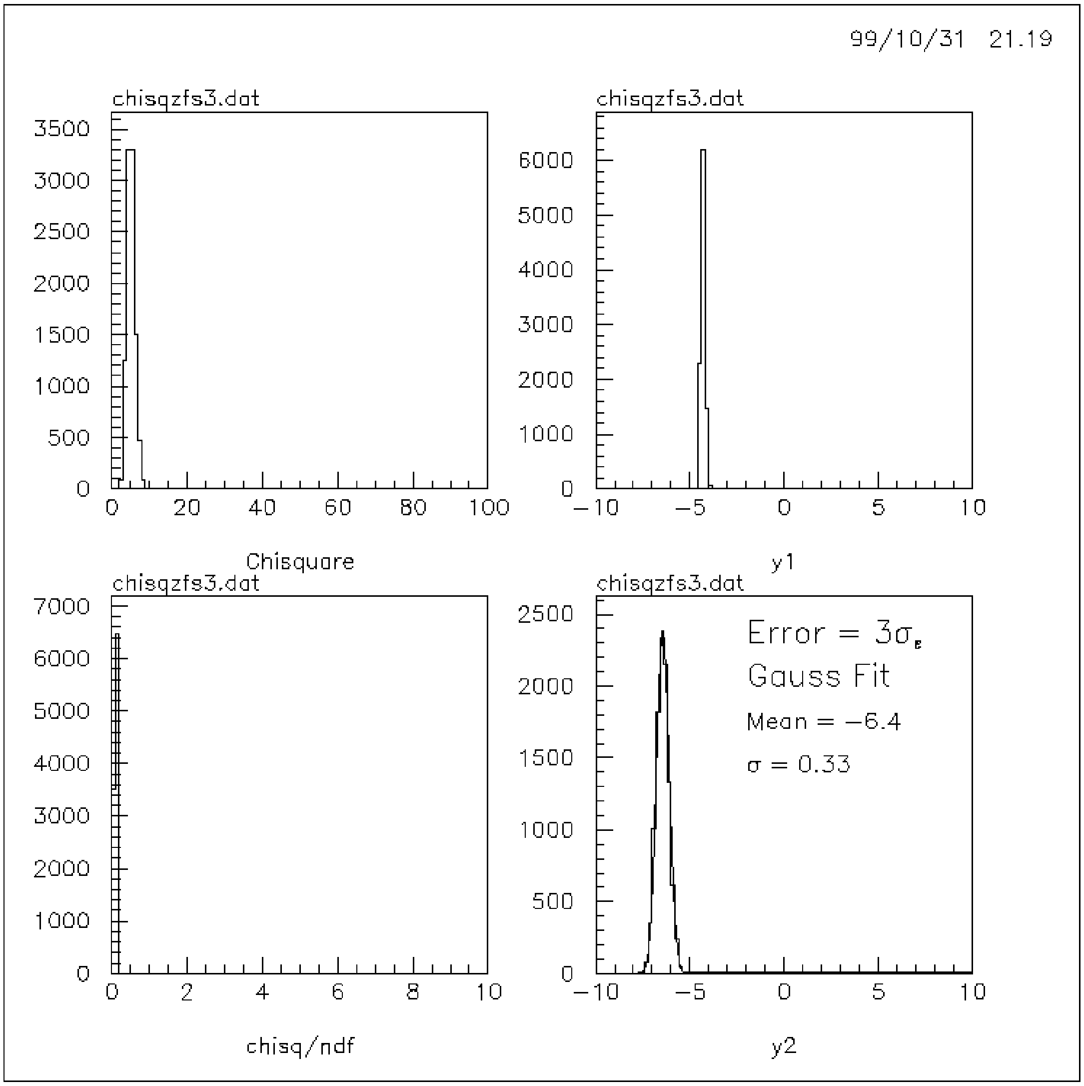

Fig. 5: MC, f = 3, (Overestimated errors)

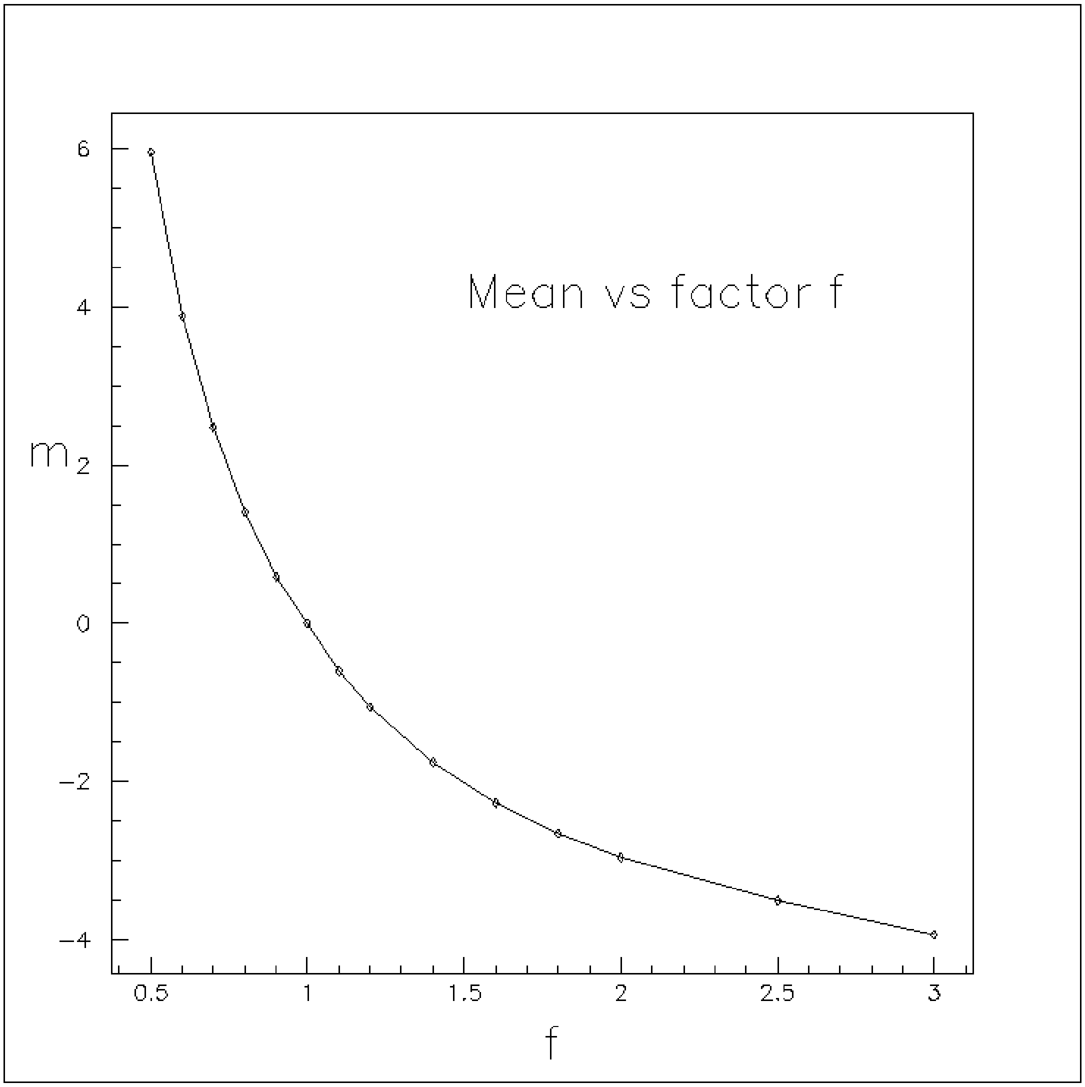

Fig. 6: MC, Position of mean vs factor f

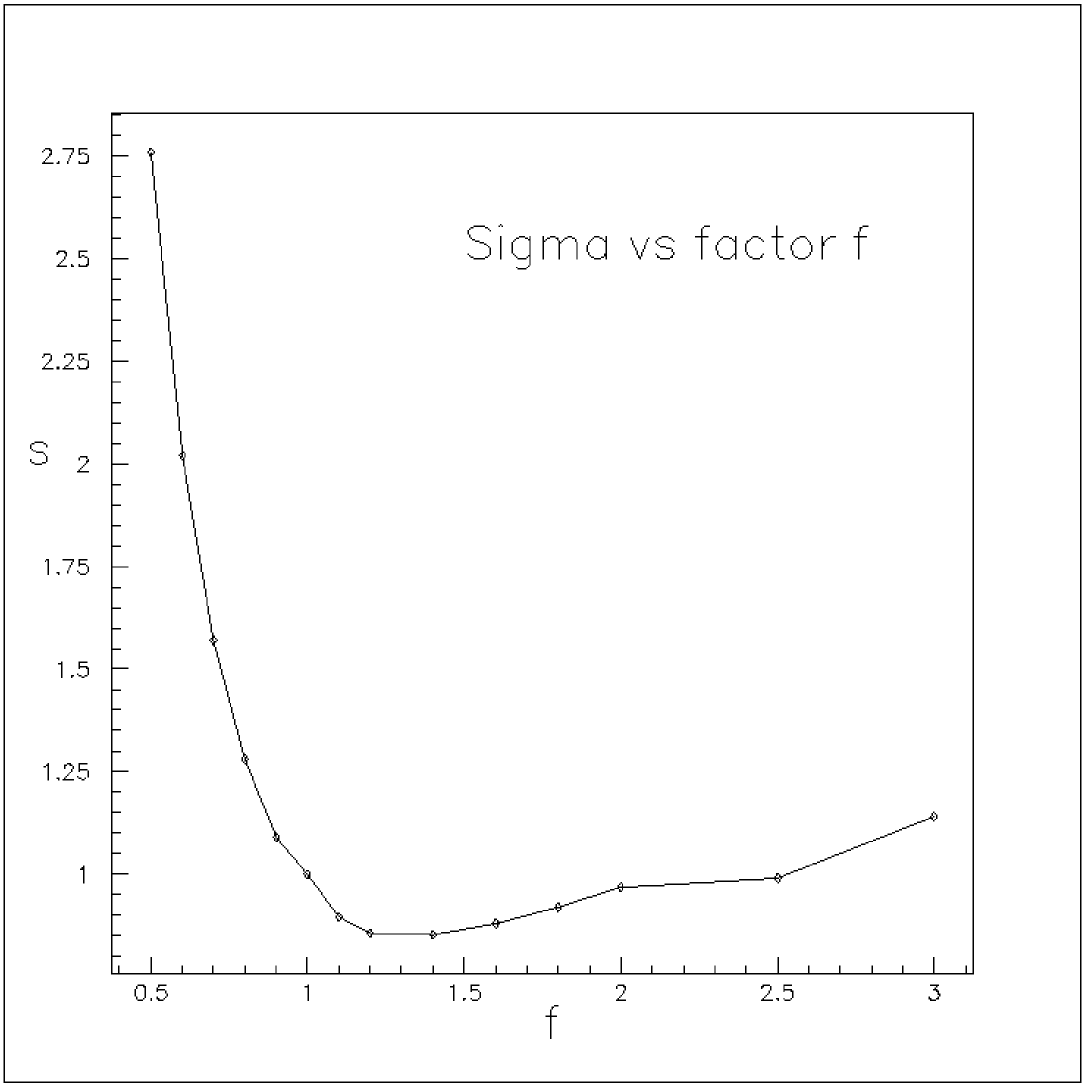

Fig. 7: MC, Sigma vs factor f

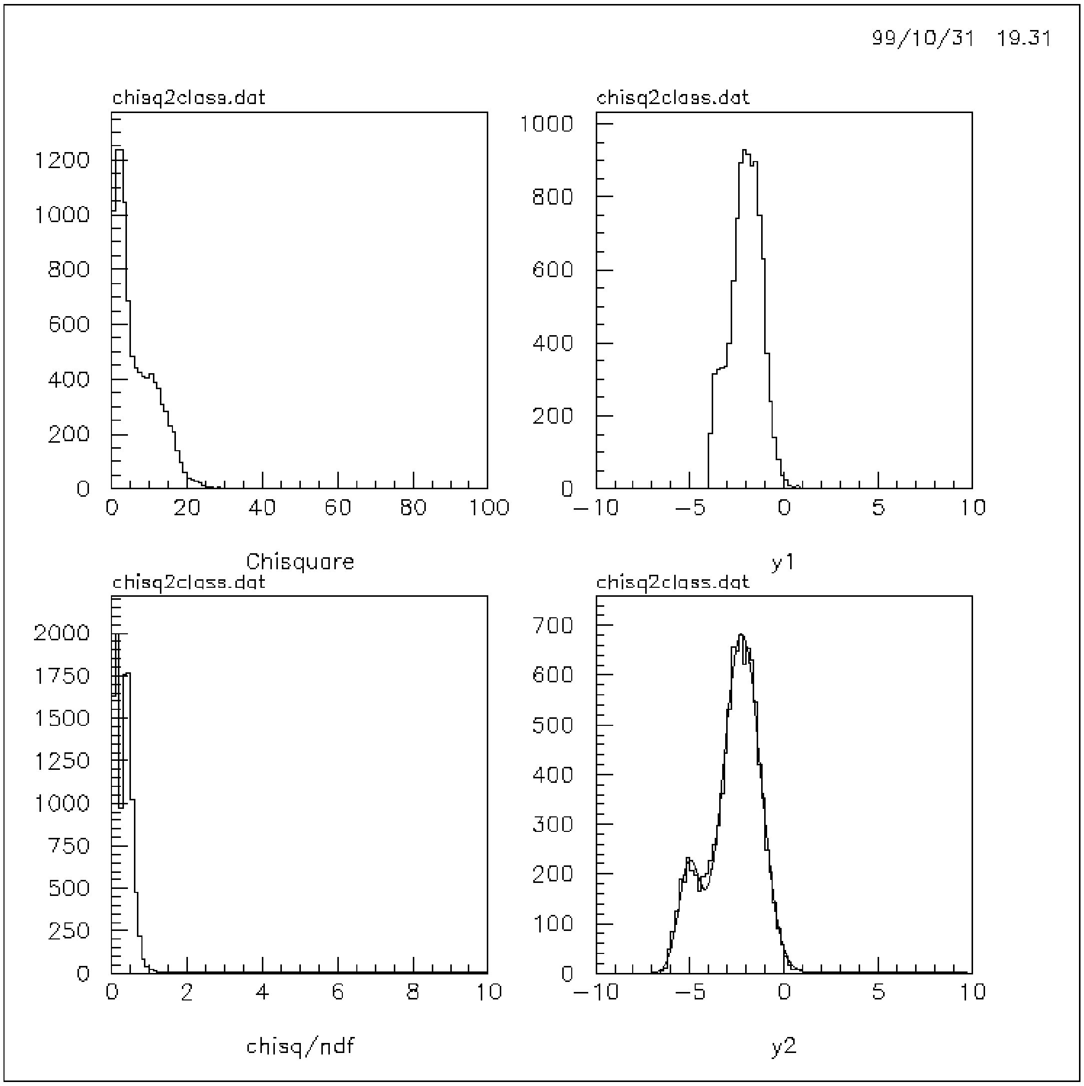

Fig. 8: MC, Two Classes of events

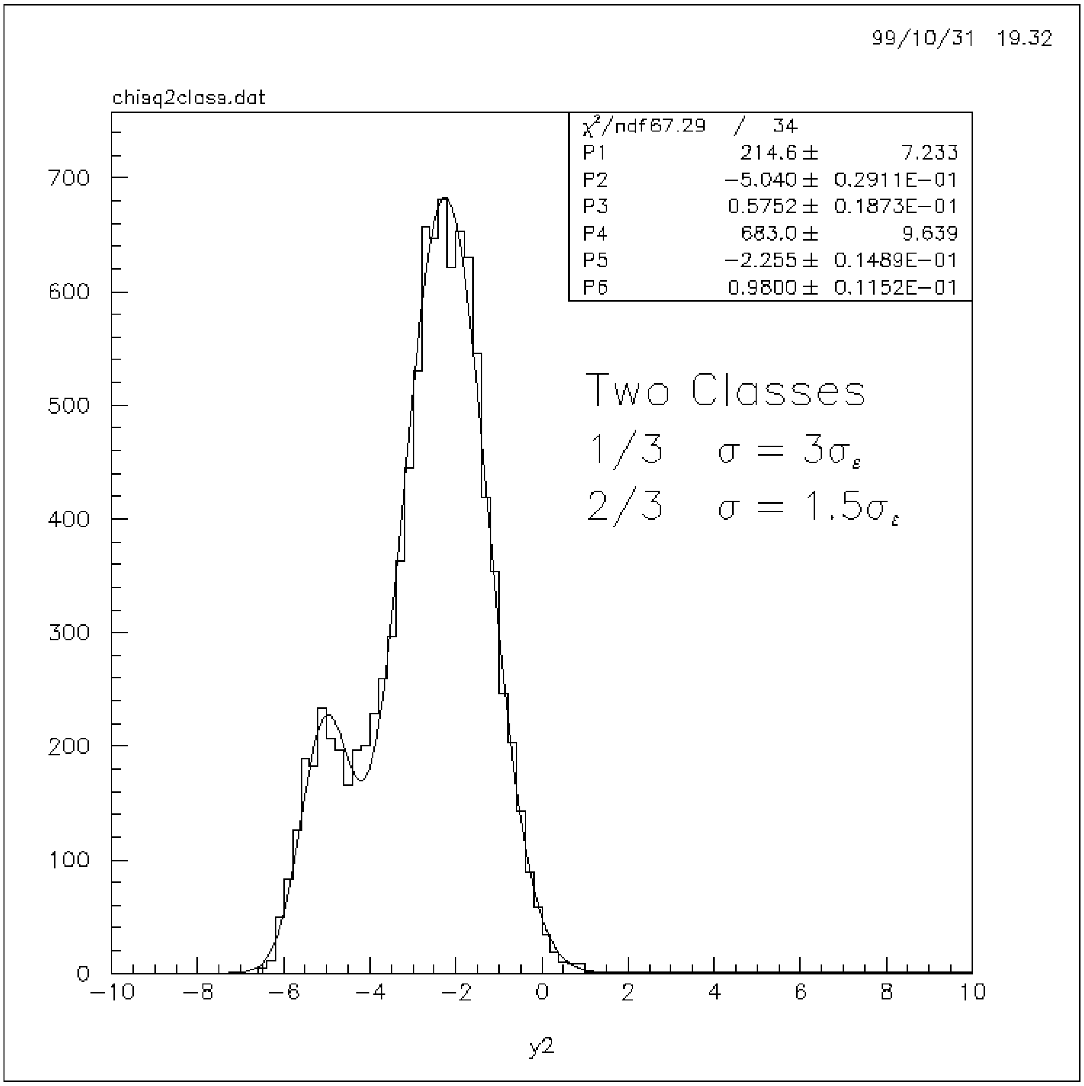

Fig. 9: MC, y_2 fits